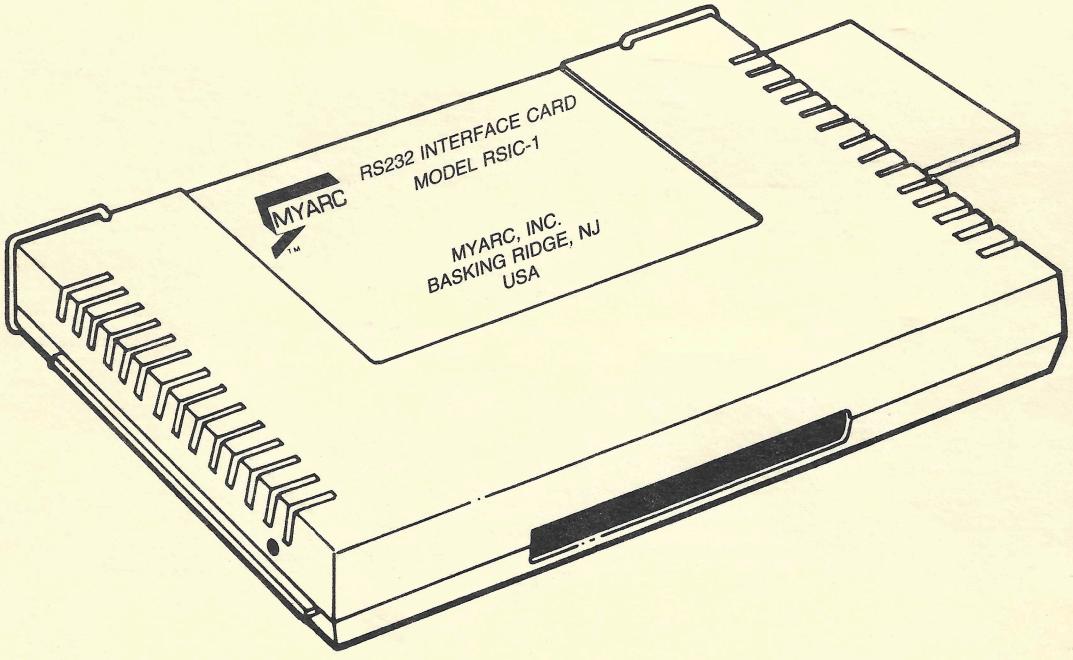
MYARC

T.M.

RS232 Interface Card

Model No. RSIC-1



MYARC, INC.
Basking Ridge, NJ

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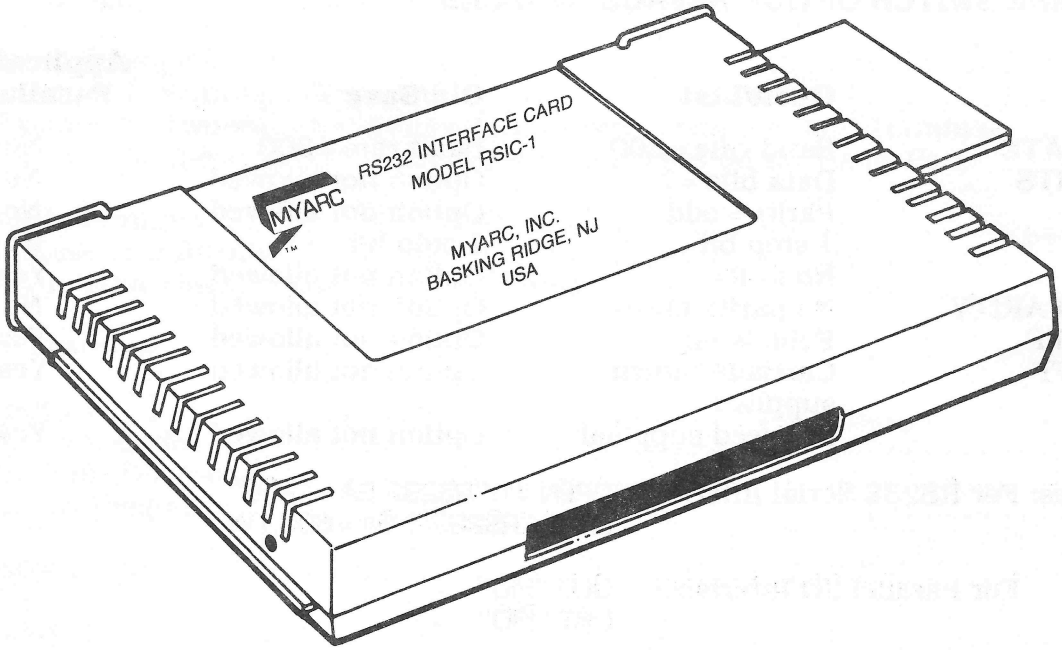
RS232 Interface Card

Model No. RSIC-1



QUICK REFERENCE GUIDE

SOFTWARE SWITCH OPTION ENTRIES

Option	Enter As	Applicable to Parallel Port
BAUD RATE = 110, 300, 600, 1200, 2400, 4800, or 9600	.BA = 300 (or desired rate)	No
DATA BITS = 7 or 8	.DA = 7 (or 8)	No
PARITY = ODD, EVEN, or NONE	.PA = O (or E or N)	No
TWO STOP BITS	.TW	No
NULLS	.NU	Yes
CHECK PARITY	.CH	No
ECHO OFF	.EC	Yes
CRLF OFF	.CR	Yes
LF OFF	.LF	Yes

SOFTWARE SWITCH OPTION DEFAULT VALUES

Option	Open/List	Old/Save	Applicable to Parallel I/O
BAUD RATE	Baud rate = 300	Baud rate = 300	No
DATA BITS	Data bits = 7	Option not allowed	No
PARITY	Parity = odd	Option not allowed	No
STOP BITS	1 stop bit	1 stop bit	No
NULLS	No nulls	Option not allowed	Yes
CHECK PARITY	No parity check	Option not allowed	No
ECHO OFF	Echo is on	Option not allowed	Yes
CRLF OFF	Carriage return supplied	Option not allowed	Yes
LF OFF	Linefeed supplied	Option not allowed	Yes

Examples: For RS232 Serial Interface:
```
OPEN #1:"RS232.BA=1200"
SAVE "RS232/2.BA=600.TW"
```

For Parallel I/O Interface:
```
OLD "PIO"
LIST "PIO"
```

TABLE OF CONTENTS

Scope of this Manual 4

Introduction 4

Set-Up Instructions 5
- Inserting the RS232 Interface Card 6
- Testing the RS232 Interface Card 7
- Removing the RS232 Interface Card 7
- Connecting Accessory Devices 7
- Addressing Accessory Devices 8

Using TI BASIC 8
- Software Switch Options 9
- Statements and Commands 11

Common Applications 16
- Exchanging Programs and SAVE and OLD Commands 17

Advanced Examples 18
- Example 1: Printing a Report 18
- Example 2: Two-way Communication between Computer and Terminal 18
- Example 3: Specifying Different Software Switches on the Same Port 19

Service Information 20
- In Case of Difficulty 20
- If You Have Questions or Need Assistance 21

Added Features 22

Appendices 23
- A. Error Codes 23
- B. Cable Diagrams 24
- C. Pin Diagrams 26

Glossary 27

Warranty 28

SCOPE OF THIS MANUAL

This manual describes the installation and operation of MYARC's Model RSIC-1 Card for use with TI's PHP 1200 Peripheral Expansion System.

Major portions of this manual, i.e., those sections dealing with technical descriptions of the TI 99/4A Home Computer System functions, their operation, and detailed instructions for system operation by the user, have been reproduced directly from TI's PHP 1220 RS232 Interface Card Manual.

Only minor changes relating to the improvements and technical advancements of the MYARC RS232 Interface Card have been made in the reproduced text.

WE RECOMMEND THAT FIRST-TIME USERS READ THE ENTIRE MANUAL BEFORE PROCEEDING WITH INSTALLATION AND OPERATION.

INTRODUCTION

The MYARC RS232 Interface Card is a communications adapter featuring 8-bit parallel and RS232 serial capabilities that enable you to connect a wide range of accessory devices to your TI Home Computer. With the RS232 Interface Card inserted into the Peripheral Expansion System, you can list programs on a printer, send and receive data from a terminal, exchange TI BASIC programs directly between TI Home Computers, and much more. By adding the Telephone Coupler (Modem) and certain *Solid State Software*™ Command Modules, your Home Computer can communicate with other computers and terminals over ordinary telephone lines. You can access an office computer or time-sharing network from your own home, using your TI Home Computer as a remote terminal to send and receive data. And you can write TI BASIC language programs which use EIA (Electronic Industry Association) Standard RS232C compatible devices, including printers, plotters, video display terminals, and other computers. In addition to its serial data feature, the RS232 Interface Card also has a parallel I/O (input/output) feature which handles input and output data that is in an 8-bit format. The parallel I/O port interfaces directly with printers that accept data in a parallel format, saving you the expense of having an RS232 Interface on the printer.

This manual shows you how to connect and test the RS232 Interface Card. Then common examples of how to use the card are given, followed by details of using TI BASIC with the RS232 Interface Card. The last section has additional, more advanced application examples.

SET-UP INSTRUCTIONS

The steps involved in inserting the RS232 Interface Card into the Peripheral Expansion System and then checking its operation are included in this section. Please read this material completely before proceeding.

Note: The Peripheral Expansion System has eight slots into which accessory cards can be inserted. The Peripheral Expansion Card must occupy slot number 1. (For information about setting up the peripheral system, refer to the Peripheral Expansion System owner's manual.) If you have a Disk Memory Drive in the Peripheral Expansion System, the Disk Drive Controller Card must be in slot number 8. Other cards can be inserted in any of the remaining slots.

CAUTION

These electronic components can be damaged by static electricity discharges. To avoid damage, do not touch the connector contacts.

Once you've unpacked the unit, you're ready to insert the RS232 Interface Card into the Peripheral Expansion System. (Save the packing material for storing or transporting the unit.)

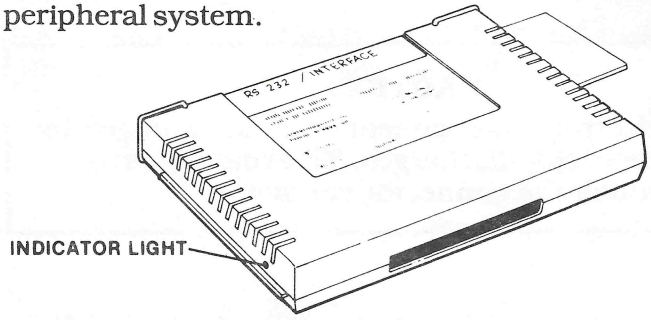
Inserting the RS232 Interface Card

1. First turn off the computer console and all attached devices.

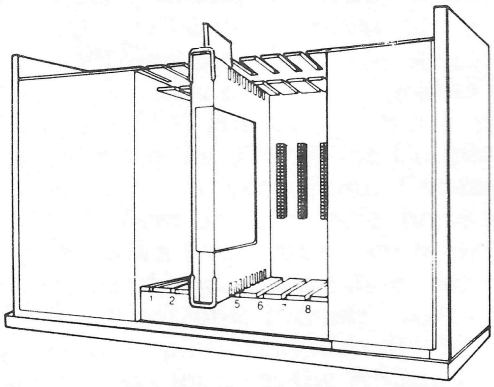
2. WARNING: TO AVOID DAMAGING ACCESSORY CARDS, WAIT TWO (2) MINUTES AFTER TURNING OFF THE UNIT FOR THE POWER TO DISCHARGE BEFORE PROCEEDING.

3. Remove the top from the peripheral system by lifting the back edge of the top and pulling up.

4. The label identifying the RS232 Interface Card is on the top of the card. An indicator light is on one side of the card. When the card is active, this light is lit and is visible at the front of the peripheral system. Hold the RS232 Interface Card with the indicator light facing the front of the peripheral system.



5. Carefully align the card with the desired slot and press the card firmly down into the slot.



6. Replace the top on the Peripheral Expansion System by sliding the front edge under the extension on the front of the unit and firmly pressing down on the back edge of the top. Do not run the system without the top in place because the top ensures proper ventilation. *Note*: If the top does not fit properly, remove the card and realign it in the slot, remembering to press down firmly until the connection is made.

CAUTION

Always disconnect the Peripheral Expansion System before moving the computer console. The cable connecting the console and peripheral system is not designed to support the weight of the units. To prevent damage, always disconnect all devices before moving any part of your Home Computer system. For long distance moves, remove all cards from the Peripheral Expansion System. Then, repack the devices in their original packing material.

Testing the RS232 Interface Card

1. The power switch is located on the front of the Peripheral Expansion System in the lower left-hand corner. Turn on the peripheral system, monitor, and console in that order.

2. A light should briefly come on in the position where you have inserted the RS232 Interface Card. Each time the computer system accesses the RS232 Interface Card, its corresponding light comes on. Note that the intensity and duration of the light varies, depending on the operation being performed within the system.

3. If the light does not come on, the corresponding card may not be properly inserted. Repeat the "Set-Up Instructions" procedure. If you still have difficulty, see "In Case of Difficulty" on page 20.

Removing the RS232 Interface Card

1. Turn OFF the Peripheral Expansion System, computer console, monitor, and any other attached accessories.

2. Wait two minutes and then remove the top from the peripheral system.

3. Remove any cables attached to the RS232 Interface Card.

4. Using two hands firmly pull up to remove the card from its slot in the peripheral system.

Connecting Accessory Devices

Once the RS232 Interface Card is properly inserted into the Peripheral Expansion System, other devices can be attached by cable to one or both of the connectors on the back of the card. One of the connectors is a parallel I/O port which enables your Home Computer to be connected to an impact printer. It is a 16-pin connector. The other connector is an RS232 serial I/O port for connection to RS232C-compatible devices. It is a 25-pin connector. A Y-cable (not made by MYARC) can be attached to the RS232 connector to allow operation with two serial I/O devices. *Note*: If both serial I/O devices are used, they are referred to as RS232/1 and RS232/2.

For your convenience, *Appendix B* contains reference information about cables and *Appendix C* provides pin diagrams.

Addressing Accessory Devices

In computer software programs written for use with the RS232 Interface Card, the circuitry through which data passes to and from external devices is called a "port," and each of these ports has a name. Usually, the serial I/O port is called RS232 or RS232/1, and the parallel I/O port is called PIO or PIO/1. If a Y-cable is connected to the serial connector on the RS232 Interface Card, a second serial I/O port can be addressed. This second port is called RS232/2.

You can also insert two* RS232 Interface Cards in the Peripheral Expansion System. If this is done, the additional serial I/O port is referred to as RS232/3. By connecting a Y-cable to the serial connector of the second card, a fourth serial I/O port is available, which is referred to as RS232/4. The additional card also provides a second parallel I/O port, which is referred to as PIO/2.

USING TI BASIC

After you've attached a peripheral to the RS232 Interface Card, the peripheral's operation can be controlled by using TI BASIC commands and statements to input and output data. These commands and statements are summarized here and are explained in detail in the "Statements and Commands" section.

- OPEN, CLOSE, INPUT, PRINT—Statements used to send and receive data between your Home Computer and other computers or accessories.
- OLD, SAVE—Commands used to send programs from one Home Computer to another.
- LIST—Command used to print or display a copy of a program.

When communicating with the RS232 Interface Card, TI BASIC recognizes five device or file names. The first three names refer to the serial I/O ports. RS232 and RS232/1 are equivalent and reference the first serial I/O port. RS232/2 references the second serial I/O port. The remaining two names refer to the parallel I/O port. PIO and PIO/1 are equivalent; both names address the parallel I/O port. Whenever an OPEN statement or a LIST, OLD, or SAVE command references one of the above names, all output or input is directed to or entered from the RS232 Interface Card.

*The second Card must be permanently modified. Generally your dealer can have this done for you.

Software Switch Options

Computer accessories often require switches to give instructions to the computer. These switches are sometimes a physical part of the product and are set by hand. With the RS232 Interface Card, however, these switches are programmed into an integrated circuit contained in the card to provide more flexibility. Since these switches are part of the card's "software," they are called *software switch options*.

Nine particular operations of the RS232 Interface are controlled with software switch options. The first four describe the characteristics of the computer or accessory with which you want to communicate. *Note*: These four operations are not used with the parallel I/O port.

- BAUD RATE—The rate (in bits per second) at which data is transferred.
- DATA BITS—The number of bits of data in each character transferred.
- PARITY—The addition of a check bit to allow checking data transmission for errors.
- STOP BITS—The number of bits sent at the end of each character.

The other five software switch options make adjustments in the operations performed by your TI Home Computer.

- CHECK PARITY—An option which verifies the data of each character received. *Note*: Also not used with the parallel I/O port.
- NULLS—An option that adds six null characters to be transmitted after each carriage return to allow for printer carriage mechanism timing.
- ECHO OFF—An option to suppress retransmission of each character received at the sender's device.
- CARRIAGE RETURN and LINEFEED OFF—An option to suppress automatic addition of a carriage return and linefeed to each variable-length DISPLAY-type record.
- LINEFEED OFF—An option to suppress automatic addition of a linefeed to each variable-length DISPLAY-type record. A carriage return is still automatically added.

These nine software switch options allow you to match your TI Home Computer to the operating characteristics of the accessory attached to the interface card. You do this by listing the switch options desired when you are entering the TI BASIC command or statement needed. All nine options are available with the serial I/O port, but only the last four can be included when you send or receive data through the parallel I/O port.

The software switch options must be designated in the OPEN statement and in the LIST, OLD, and SAVE commands. Since CLOSE, INPUT, and PRINT statements operate with previously opened files, switch options are not necessary.

To make things as easy as possible for you, the RS232 Interface assumes certain switch settings, called default values. You only have to specify those settings you need to change from the default values.

Software Switch Options and Default Values

SOFTWARE SWITCH OPTION DEFAULT VALUES

Option	Open/List	Old/Save	Applicable to Parallel I/O
BAUD RATE	Baud rate = 300	Baud rate = 300	No
DATA BITS	Data bits = 7	Option not allowed	No
PARITY	Parity = odd	Option not allowed	No
STOP BITS	1 stop bit	1 stop bit	No
NULLS	No nulls	Option not allowed	Yes
CHECK PARITY	No parity check	Option not allowed	No
ECHO OFF	Echo is on	Option not allowed	Yes
CRLF OFF	Carriage return supplied	Option not allowed	Yes
LF OFF	Linefeed supplied	Option not allowed	Yes

If you want to specify different values, the following software switch options can be entered. In a file name the switch options follow RS232, RS232/1, or RS232/2 for the serial I/O port or PIO or PIO/1 for the parallel I/O port.

SOFTWARE SWITCH OPTION ENTRIES

Option	Enter As	Function
BAUD RATE = 110, 300, 600, 1200, 2400, 4800, or 9600	.BA = 300 (or desired rate)	Sets the transmission rate.
DATA BITS = 7 or 8	.DA = 7 (or 8)	Determines the number of data bits in each character.
PARITY = ODD, EVEN, or NONE	.PA = O (or E or N)	Determines type of parity checking.
TWO STOP BITS	.TW	When this switch is on, stop bits are used.
NULLS	.NU	When this switch is on, nulls are used.
CHECK PARITY	.CH	When this switch is on, parity checking is performed.
ECHO OFF	.EC	When this switch is on, the echo feature is turned off.
CRLF OFF	.CR	When this switch is on, the carriage return and linefeed options are turned off.
LF OFF	.LF	When this switch is on, the linefeed feature is turned off.

The first three options assign values to a switch and must include an equals sign (=). The remaining six switches are of the "on-off" variety and, as shown, are entered with a decimal point and then the two-letter designation. The switch options may be listed in any order in your program statement or command.

Statements and Commands

In this section, TI BASIC statements and commands are discussed only as they relate to the RS232 Interface Card. For a more general explanation of TI BASIC, see the BASIC Reference Section of the *User's Reference Guide*.

The OPEN Statement

The OPEN statement prepares a TI BASIC program to use data files with accessory devices. When used with the RS232 Interface Card, it links the attached peripheral to a file-number and sets the software switch options to control the interface operations.

The format for the OPEN statement with the RS232 Interface Card is:

OPEN *#file-number:"file-name[.software switch options]"[,file-attributes]*

- *File-number* is a numeric expression that evaluates to an integer between 1 and 255.
- *File-name* is a string expression containing one of the five names used with the RS232 Interface Card: RS232, RS232/1, or RS232/2 when using the serial I/O port, or PIO or PIO/1 when using the parallel I/O port. The *file-name* is optionally followed by a list of *software switch options*. For those options not listed, the computer assumes the default values listed in the "Software Switch Options" section.
- *File-attributes* are string expressions, separated by commas, which specify the length and format of records, the file organization, and how the file is accessed. The possible entries and default values for the RS232 Interface Card are:

Entry	RS232 Interface Card Default
file-organization: SEQUENTIAL only (RELATIVE files cannot be used)	SEQUENTIAL
file-type: DISPLAY or INTERNAL	DISPLAY
open-mode: INPUT, OUTPUT, UPDATE, or APPEND	UPDATE
record-type: FIXED or VARIABLE [record length]	VARIABLE 80

PLEASE NOTE

Please review Item #1, "Simplified Device Name for the RS232 Serial Port" in the Section "Added Features" on page 22.

For the examples in the Statements illustrated in this Section, and the examples shown in Common Applications on page 16 and Advanced Examples shown starting on page 18, you may generally substitute the simplified device name "P" for "RS232."

The following examples are open statements for serial I/O.

```
Example 1:  OPEN #1: "RS232"
Example 2:  OPEN #A: "RS232.BA=9600.EC.CH"
Example 3:  OPEN #B: "A$",FIXED 32
            where: B = 3
                   A$ = RS232/2.TW.BA=110
```

The following are examples for parallel I/O.

```
Example 4:  OPEN #1: "PIO.EC"
Example 5:  OPEN #2: "PIO/1.EC.LF"
```

In the first example, all default values are assumed on port 1. In the second example, file A on port 1 has a baud rate of 9600, the echo feature is turned off, and parity checking will occur. The device opened in the third example is attached to port 2, two stop bits are transmitted, the baud rate is 110, and the record type is set to a fixed length of 32 characters. In the fourth example, file 1 is opened on the parallel I/O port, and the echo feature is turned off. In the last example, file 2 is opened on the parallel I/O port and both the echo and line feed features are turned off.

The CLOSE Statement

The CLOSE statement "closes" or discontinues the association between the file specified by the *file-number* and a program.

The format for the CLOSE statement is:

CLOSE *#file-number*

The INPUT Statement

When you use the INPUT statement with a device connected to the RS232 Interface Card, data can be transmitted from the device and assigned to the variables listed in the statement. The format for this form of the INPUT statement is:

INPUT *#file-number:variable-list*

To use the INPUT statement with a device attached to the RS232 Interface Card, the device must be opened in INPUT or UPDATE mode.

- *File-number* is a numeric expression that evaluates to an integer between 1 and 255.
- *Variable-list* is a group of variables to which data are assigned.

The number of characters returned by the INPUT statement depends on the record type specified in the OPEN statement. For FIXED length or INTERNAL data type records, data are accepted from the device until (1) the number of characters equals the record length specified in the OPEN statement or (2) **CLEAR** is pressed on the main console, which stops the program. For VARIABLE length records, input is accepted from the RS232 Interface Card until (1) a carriage return (or **ENTER**) is pressed, (2) the maximum record length specified in the OPEN statement is reached, or (3) **CLEAR** is pressed on the main console, stopping the program.

An added feature of the RS232 Interface Card is its editing capability. Before pressing the carriage return or ENTER key, the person sending data from a terminal can delete characters and recheck the data before transmission. To use the editing feature, follow this procedure:

1. Be sure the OPEN statement for this device specifies DISPLAY type data.

2. Be sure the echo and edit capability is functioning (do not specify ECHO OFF in the corresponding OPEN statement).

3. Press the terminal's DELETE key (decimal code 127). This causes the previously transmitted character to be removed from the RS232 Interface buffer so that it is not sent to the computer. The deleted character is echoed back to the sending terminal.

4. To see what remains in the RS232 buffer after several deletions, press the terminal's CONTROL R key (decimal code 18). This sends a carriage return, a linefeed, and the buffer contents back to the sending terminal so that you can see what is ready to be entered.

If the ECHO OFF (.EC) software switch option or INTERNAL data is specified in the OPEN statement, the editing features are ignored. Pressing DELETE or the CONTROL R key on the terminal, in this case, results in the corresponding code being stored in the RS232 Interface buffer.

The PRINT Statement

To send data from the Home Computer to an accessory device via the RS232 Interface Card, the format for the PRINT statement is:

PRINT *#file-number[:print-list]*

- *File-number* is a numeric expression that evaluates to an integer between 1 and 255.

- *Print-list* is a group of variables to which data is assigned.

The device must be opened in the OUTPUT or UPDATE mode.

When data is transmitted to a device through the RS232 Interface Card, a carriage return and linefeed code are sent after each record unless:

- INTERNAL type data or FIXED length records was specified in the corresponding OPEN statement.

- CARRIAGE RETURN — LINE FEED OFF (.CR) or LINE FEED OFF (.LF) was specified in the OPEN statement.

Two Home Computers can print and input to each other through their respective RS232 serial or parallel I/O ports. While one computer prints data out, the other can receive the data with an INPUT statement. Since data entered on the console of a Home Computer is immediately displayed, the receiving RS232 serial or parallel I/O interface should not echo data back. List the ECHO OFF (.EC) option and LINE FEED OFF (.LF) option in the OPEN statement when two Home Computers print and input to each other. The first example in the "Common Applications" section illustrates how two Home Computers can communicate with each other.

Note: When you use the parallel I/O port, specify the ECHO OFF (.EC) feature in the OPEN statement.

The LIST Command

Program lines can be displayed on an accessory device through the RS232 Interface Card by using the LIST command in the following format:

LIST *"file-name[.software switch options]"[:line-list]*

Here again the *file-name* must be RS232, RS232/1, or RS232/2 when using the serial I/O port, or PIO or PIO/1 when using the parallel I/O port. The *software switch options* and their default values are listed in the "Software Switch Options" section. The *line-list* is any valid list as explained in the BASIC Reference Section of the *User's Reference Guide*.

The following examples are list statements for serial I/O.

```
Example 1: LIST "RS232"
Example 2: LIST "RS232/1.BA=600.DA=8.PA=E"
Example 3: LIST "RS232/2.BA=1200": 100-200
```

The following examples are list statements for parallel I/O.

```
Example 4: LIST "PIO"
Example 5: LIST "PIO/1": 100-200
```

The first example assumes all the default values through port 1. The second example also uses port 1 but changes the baud rate to 600, the data bits to 8, and the parity to even. The third example uses port 2 and a baud rate of 1200. The first two examples list all program lines in memory while the third lists the lines between 100 and 200, inclusive. The last two examples list similar information via the parallel I/O port.

The SAVE and OLD Commands

Programs can be exchanged between TI Home Computers when they are connected by modems over the telephone network or if their respective RS232 Interface Cards are directly cabled together. The SAVE and OLD commands are used in the following formats:

SAVE *"file-name[.software switch options]"*
OLD *"file-name[.software switch options]"*

The *file-name* must be RS232, RS232/1, or RS232/2 when using the serial I/O port or PIO or PIO/1 when using the parallel I/O port. For the RS232 serial I/O ports, the only software switch options allowed are baud rate (.BA) and number of stop bits (.TW). For the parallel I/O port, no switch options are allowed. The number of data bits is always 8 when exchanging programs. The default values are shown in the "Software Switch Options" section. Corresponding SAVE and OLD commands must specify the same baud rate and number of stop bits when using the serial I/O port.

The following examples are save and old commands for serial I/O.

Example 1: SAVE "RS232/2.BA=600.TW"
Example 2: OLD "RS232.BA=600.TW"

The following examples are save and old commands for parallel I/O.

Example 3: SAVE "PIO.HS" *
Example 4: OLD "PIO/1.HS" *

See the "Common Applications" section for the procedure required to exchange programs.

The following table indicates the speed at which one record is exchanged between computers when using the I/O ports. The transfer time, expressed in seconds, is next to the baud rate you are using.

TRANSFER TIMES FOR A 256-BYTE RECORD

Baud Rate	Seconds
RS232 Serial I/O	
110	23.5
300	8.6
600	4.3
1200	2.5
4800	0.5
9600	0.3
Parallel I/O	0.1

*See Item 3, Parallel Handshake Option under Added Features, page 22. The Handshake Option must be ON when exchanging programs between computers.

COMMON APPLICATIONS

One common application of your RS232 Interface Card involves communicating with another TI Home Computer. Two examples are shown here. The first shows how messages can be exchanged between TI Home Computers, and the second illustrates how a TI BASIC program can be transferred from one TI Home Computer to another. The examples assume that both TI Home Computers have RS232 Interface Cards which are connected by a cable. However, the same procedure works using telephone lines when each line has a TI Telephone Coupler (modem) attached to the RS232 Interface Card.

Communication between Home Computers

In this example, two TI Home Computers are sending and receiving messages through a cable attached to the serial I/O, RS232 port (port 1) of each RS232 Interface Card. (See *Appendix B* for cable information for Home Computers and modems.) Below are the program listings: one for User A and one for User B.

User A enters the program on the left into computer A; User B enters the program on the right into computer B. Then User B's program should be RUN before User A's. When both programs are running, User A sends the first message. When a message is entered on User A's computer, it is transmitted via the RS232 Interface Card and displayed on User B's screen. Then User B can enter a message to be sent to User A. Messages are sent by typing the words and then pressing **ENTER**. This process of alternately sending messages between A and B can continue until the programs are stopped by pressing **CLEAR** on both computers.

```
100 REM-USER A
200 OPEN #1:"RS232.EC.LF",
VARIABLE 255
300 INPUT A$
400 PRINT #1:A$
500 INPUT #1:B$
600 PRINT B$
700 GOTO 300
800 END
```

```
100 REM-USER B
200 OPEN #1:"RS232.EC.LF",
VARIABLE 255
300 INPUT #1:A$
400 PRINT A$
500 INPUT B$
600 PRINT #1:B$
700 GOTO 300
800 END
```

Note that in line 200, the serial I/O port is opened, and the echo feature is turned off. The reason that the echo feature is turned off is because, in this example, information is to be transmitted in only one direction at a time. Thus, it is not necessary to have data echoed back. However, RS232 serial I/O ports may send and receive information simultaneously. When such two-way transmission is desired, the echo feature must be used. Parallel I/O ports, on the other hand, can transmit information in only one direction at a time. Therefore, they do not require information to be echoed back. If transmission is by parallel I/O ports, the echo feature must be turned off. To do this, the term RS232 in line 200 is simply replaced by the term PIO.HS.

Exchanging Programs with SAVE and OLD Commands

This example demonstrates transferring a TI BASIC program from one TI Home Computer to another. After the program transfer is complete, the receiving computer can use the program just as if it had been entered there. This procedure is useful for exchanging programs without having to reenter the program statements from the keyboard.

If transmission is over the telephone, programs are exchanged by the following procedure:

1. Call the other user; then place your phone in the modem. See the modem owner's manual for specific instructions.

2. The sender types SAVE "RS232" or SAVE "RS232/1" (or "RS232/2" if the second serial I/O port is used) and presses **ENTER**.

3. The receiver types OLD "RS232" or OLD "RS232/1" (or "RS232/2" if the second serial I/O port is used) and presses **ENTER**.

4. The number 255 then appears at the top center of each computer display. Once the link is established, this value is replaced by the number of 256-character records remaining to be exchanged. This value decreases as each record is transferred. When it reaches zero, the complete program has been transmitted.

5. If the number 255 remains on the screen longer than 10 seconds, the person at the receiving end must press **CLEAR** and reenter the OLD command.

Note: If the two computers are attached by direct cable through the parallel I/O ports, the procedure is the same as in Steps 2 through 5, except that the SAVE and OLD commands should be SAVE "PIO.HS" and OLD "PIO.HS".

These are just two examples of ways to use the RS232 Interface Card. In addition to TI BASIC programs, certain Command Modules also use the RS232 Interface Card. For example, the Terminal Emulator module allows you to use the interface unit and Telephone Coupler to access time-sharing computer services. Check with your local dealer for information about these modules and other accessories and services available for use with the RS232 Interface Card.

ADVANCED EXAMPLES

The three example programs in this section illustrate three tasks commonly performed by an RS232 Interface Card.

Example 1: Printing a Report

This program prints a table listing the numbers from 1 to 10, including the squares and cubes of these numbers, using the parallel I/O port.

```
100 OPEN #1:"PIO"
200 PRINT #1:"X", "X ^ 2", "X ^ 3"
300 FOR K=1 TO 10
400 PRINT #1:K,K ^ 2, K ^ 3
500 NEXT K
600 CLOSE #1
700 END
```

Line 100 opens the attached device using the default software switch options. Line 200 prints a heading. Lines 300-500 loop through the whole numbers from 1 to 10, inclusive, and print the table. Line 600 disassociates the specified file from the RS232 Interface Card.

Example 2: Two-way Communication between Computer and Terminal

This program can be used by a Home Computer with a video display terminal connected to serial I/O port 1 of the RS232 Interface Card.

```
100 CALL CLEAR
200 OPEN #1:"RS232/1.BA=9600",VARIABLE 112
300 INPUT "TYPE MESSAGE: ":X$
400 PRINT #1::"MESSAGE FROM HOME COMPUTER: ":X$::
500 PRINT #1:::"TYPE MESSAGE: ";
600 INPUT #1:X$
700 PRINT:::"MESSAGE FROM TERMINAL: ":X$::
800 GOTO 300
```

The terminal is opened in line 200, specifying a baud rate of 9600. The other software switch options have the default values. VARIABLE records are specified because the message will vary in length. The maximum number of characters accepted by an INPUT statement is 112, so this is the value specified as the maximum record length. If you are using a mechanical terminal, turn on the NULLS (.NU) software switch option. This gives the carriage return time to move back to the first column.

The program first accepts a message from the Home Computer and transmits it to the terminal (lines 300 and 400). In lines 500-700, the terminal user is prompted to enter a message which is displayed on the Home Computer screen. Line 800 lets this exchange of messages continue until **CLEAR** is pressed to stop the program.

Example 3: Specifying Different Software Switches on the Same Port

This program demonstrates how you can simultaneously use a single device in more than one way. Initially, the program opens a terminal as files 1, 2, and 3 on port 1. Line 100 specifies that output to file #1 should include a return and linefeed after each record. Line 110 indicates that data from file #2 will have variable length ASCII text and will not be echoed back to the terminal. Lines 110 and 120 show that data will be printed on file #3 and the cursor will stay on the same line after it is printed.

```
100 OPEN #1:"RS232"
110 OPEN #2:"RS232.EC"
120 OPEN #3:"RS232.CR"
130 PRINT #3:"ENTER THE WORD PASSWORD"
140 INPUT #2:A$
150 IF A$="PASSWORD" THEN 180
160 PRINT #1:"TRY AGAIN"
170 GOTO 130
180 PRINT #1:"PASSWORD IS OK"
190 GOTO 130
```

SERVICE INFORMATION

In Case of Difficulty

If the RS232 Interface Card does not appear to be working properly, check the following:

1. *Power* — Be sure the peripheral system is plugged in and turned on. Also, check to be sure that the fuse is not blown by looking at the fuse to see if the wire is unbroken.

2. *Card Position* — Turn the power OFF, wait two minutes, and remove the top from the peripheral system. Verify that all cards are inserted properly and then replace the top.

3. *Home Computer* — Check to see that the Home Computer works properly with all accessories disconnected.

4. *Peripheral Expansion System* — Check for proper connection between the console and peripheral system.

5. *Cables* — Data Communication Equipment (DCE*) devices, such as modems and other home computers, require the connection shown in *Appendix B*. Data Terminal Equipment (DTE*) devices, such as terminals and printers, require a different cable, also shown in *Appendix B*. Be sure the correct cable is being used. Check for loose or broken leads. Be sure cables are plugged into control ports.

6. *Proper Software Switch Options Selection* — Even when all hardware is operating properly, the RS232 Interface Card can appear to malfunction if improper software switch options have been selected. Check the requirements of the terminal or modem attached to the RS232 Interface Card and be sure they correspond to the options selected in the OPEN statement and in the LIST, OLD, or SAVE commands. A 300-baud printer will not operate if the RS232 Interface Card is opened at 1200 baud. Refer to your printer manual for the option selection procedure. If maximum ease of programming is desired, set your printer or modem to the default values specified in the "Software Switch Options" section. When communicating between Home Computers, omitting the ECHO OFF (.EC) or LINEFEED OFF (.LF) options in an OPEN statement may cause unpredictable results.

7. *Test Mode* — In regard to other modems and terminals, if the device has a test or local mode, use it to verify that the device is working properly when it is disconnected from the RS232 Interface Card.

*Per the EIA RS232C Standard

If the RS232 Interface Card or attached devices still do not appear to be working properly, first turn all power off. Next, remove the RS232 Interface Card from the Peripheral Expansion System and the cables to attached devices. Then follow these steps:

1. *See if the Home Computer is working properly with only the Peripheral Expansion System connected.* Turn off the Home Computer. Disconnect all accessories. Check that the Peripheral Expansion System (without the RS232 Interface Card in its slot) is connected. Turn on the Home Computer. Press any key and the master selection list appears. Now select TI BASIC. Type: OPEN #1:"RS232" and press **ENTER**. The error message "I/O ERROR 00" should be displayed, indicating that the device named could not be opened. (This is the result expected if the RS232 Interface Card is not inserted in the Peripheral Expansion System.)

2. *Check that the RS232 Interface Card is working properly.* Refer to the "Set-Up Instructions" section and reconnect the RS232 Interface Card. Type: OPEN #1:"RS232" and press **ENTER**. Contents of the screen should scroll up two lines, indicating that the device named has been opened.

3. If any device when reattached to the RS232 Interface Card still does not work, then the device or its cable may be faulty. Cable pin connections (pinouts) are defined in *Appendix B.*

4. If none of the above procedures corrects the difficulty, consult "If You Have Questions or Need Assistance" or see the "Maintenance and Service Information" section of the *User's Reference Guide.*

IF YOU HAVE QUESTIONS OR NEED ASSISTANCE

If you have questions concerning Model RSIC-1 RS232 Interface Card operation or repair, contact first the dealer from whom you purchased the equipment.

Your dealer will be able to quickly answer most questions. If your dealer doesn't have an immediate answer, the dealer will either contact MYARC or suggest you contact us directly by mail or phone.

Our address and telephone number are:

MYARC, INC.
P.O. Box 140
Basking Ridge, N.J. 07920

(201) 766-1701

Please Note: This telephone number is not a toll-free number and collect calls cannot be accepted.

Four new utility features have been incorporated into MYARC's RSIC-1 Card. Please note: These features were not described earlier in this Manual. Most users will be able to easily utilize the first three features. The remaining feature will be of more interest to the advanced user.

1. SIMPLIFIED DEVICE NAME FOR THE RS232 SERIAL PORT — "P"
   The present TI system assigns two choices for a single RS232 serial port — "RS232" or "RS232/1". Most users use the serial port to interface (connect) to a printer.

   We have added a new utility which assigns a third choice — "P". Now you can simply type in "P" instead of typing in "RS232" or "RS232/1". If you're in BASIC, for example, enter: LIST "P".

   Similarly when using TI-WRITER, enter "P" for device name and follow "P" with the appropriate switch options:

   P.BA=(printer baud rate).CR or .LF, etc.

2. MAXIMUM BAUD RATE (SPEED) DOUBLED FROM 9600 to 19200 BAUD
   If you have a printer, modem, or other device that can operate at the higher baud rate = 19200, you can now take advantage of that higher speed, — use the switch option ".BA=19200".

3. PARALLEL HANDSHAKE OPTION — ".HS"
   This feature increases the variety of printers that may be connected to your parallel I/O port.

The ".HS" handshake option defaults to OFF. If ".HS" is ON, then the output strobe will continue to function as a "handshake", i.e., when output is valid, the output strobe is set "low". The strobe remains low until the input busy signal is set "high".

TI handled the strobe in this manner to allow use of the "LOAD/SAVE" function via PIO. In executing a "LOAD/SAVE" via PIO, the strobe actually functions as a "handshake" signal, not as a strobe. The one limitation with this approach is that the PIO port does not function as a fully standard parallel interface to printers.

To conform to standard, the strobe should normally be "high" and go "low" when the output is valid, then "high" (6μsec, minimum) without respect to the busy input. Accordingly, this added MYARC software provides standard operation of the PIO port. If the user wants to use the strobe as the handshake, then the ".HS" switch option should be included in the device name.

4. PARALLEL I/O INVERTED BUSY INPUT OPTION — ".IB"
   This inverted busy signal option defaults to "off". If the switch ".IB" is included in the device name, the option is ON and the busy signal logic is assumed to be inverted, i.e., high = not busy, and low = busy.

APPENDIX A — Error Codes

Listed below are the error codes related to the operation of TI BASIC programs that use the RS232 Interface Card.

OPEN:

CODE 00 — Device named in the statement or command cannot be opened.
CODE 02 — The software switch option entry is in error, such as incorrect first two characters of an option, invalid BAUD rate, or incorrect number of data bits, as well as RELATIVE record type specified in the OPEN statement.
CODE 06 — A hardware error occurred and the device cannot be opened.

INPUT:

CODE 24 — INTERNAL data type record is too large to be read into the buffer space allocated.
CODE 26 — Some type of hardware error occurred. Also caused by pressing **CLEAR** to stop the reception of a pending or in progress operation.

PRINT:

CODE 36 — See INPUT code 26.

OLD:

CODE 50 — Program cannot be loaded from the specified device.
CODE 52 — Attempting to use .EC, .CR, .LF, .NU, or .DA switch with OLD statement. Also see OPEN code 02.
CODE 54 — The program is too large to be loaded.
CODE 56 — See INPUT code 26.

SAVE:

CODE 60 — Program cannot be saved to the specified device.
CODE 62 — Attempting to use .EC, .CR, .LF, .NU, or .DA switch with SAVE statement. Also see OPEN code 02.
CODE 66 — See INPUT code 26.

MISC ERROR CODES:

CODE 43,73,83,93 — Executing an illegal command.

APPENDIX B — Cable Diagrams

Cables used to connect other computers, modems, or terminals to the RS232 Interface Card must use EIA RS232C 25-pin male connectors. For the first serial I/O port (RS232/1), the pins are defined as follows:

Pin #	*Mnemonic*	*Output/Input*	*Function*
1		Ground	Protective ground
2	RD	Input	Serial data into RS232/1
3	TX	Output	Serial data out of RS232/1
5	CTS	Output	Clear to send for RS232/1
6	DSR	Output	Data set ready (1.8-kilohm pull-up resistor to +12V)
7		Ground	Logic or signal ground
8	DCD	Output	Data carrier detect for RS232/1
20	DTR	Input	Data terminal ready for RS232/1

Pins listed above are required in either one or both of the cables diagrammed below. All unlisted pins need not be wired. It does not matter which end of the cable you plug into the RS232 Interface Card or the device. Be sure both ends are wired as follows:

Required Pin Wiring for Connecting Two Home Computers Either by Direct Cables or Modems

RS232	*Computer/Modem*
1	1
2	3
3	2
6	20
7	7
20	6

Required Pin Wiring for Terminals

RS232	*Terminal*
1	1
2	2
3	3
5*	5
6*	6
7	7
8*	8
20	20

*Not required for proper operation of the RS232 Interface Card, but may be required for proper operation of accessory devices.

If a Y-cable is made for connecting a device to the second serial I/O port (RS232/2), the pins are defined as follows:

Pin #	*Mnemonic*	*Output/Input*	*Function*
1		Ground	Protective ground
6	DSR	Output	Data set ready (1.8-kilohm pull-up resistor to + 12V)
7		Ground	Logic or signal ground
12	DCD	Output	Data carrier detect for RS232/2
13	CTS	Output	Clear to send for RS232/2
14	RD	Input	Serial data into RS232/2
16	TX	Output	Serial data out of RS232/2
19	DTR	Input	Data terminal ready for RS232/2

The preceding pin-definition information can be used to make a Y-cable as follows.

Required Pin Wiring for Connecting Two Devices to the RS232 Interface Card

RS232/1	*Device 1*	*RS232/2*	*Device 2*
1	1	1	1
2	2	14	2
3	3	16	3
5*	5	13*	5
6*	6	6*	6
7	7	7	7
8*	8	12*	8
20	20	19	20

*Not required for proper operation of the RS232 Interface Card, but may be required for proper operation of accessory devices.

The pins for the parallel I/O port are defined as follows.

Pin #	*Function/Description*
1	Handshake OUT
2	Data, LSB
3	Data
4	Data
5	Data
6	Data
7	Data
8	Data
9	Data, MSB
10	Handshake IN
11	Logic ground
12	10-kilohm pull-up resistor to +5V
13	No connection
14	Logic ground
15	1-kilohm pull-up resistor to +5V
16	Logic ground

APPENDIX C — Pin Diagrams

RS232 Female Connector Data Set Pin Definitions

Pin #	*Type*	*Function*
1	Driven	Protective ground
2	Received	Data to UART0
3	Driven	Data from UART0
5	Driven	Clear to send CRU out, U0
6	Driven	1.8 kilohm pull-up resistor to + 12V
7	Driven	Logic ground
8	Driven	Data carrier detect UART0
12	Driven	Data carrier detect UART1
13	Driven	Clear to send CRU out, U1
14	Received	Data to UART1
16	Driven	Data from UART1
19	Received	Data terminal ready UART1
20	Received	Data terminal ready UART0

GLOSSARY

ASCII — The American Standard Code for Information Interchange which is a standard data transmission code that was introduced to achieve compatibility between data devices. It consists of seven information bits and one parity bit for error-checking purposes, thus allowing 128 code combinations. If the eighth bit is not used for parity, 256 code combinations are possible.

Baud — The transmission rate of data over a communication line. 300 baud indicates 300 bits of information are being transmitted every second.

Bit — The fundamental unit of binary information symbolized by 0 (off) and 1 (on).

Byte — A string of binary digits or bits treated as a unit, often representing one data character.

Echo — The immediate retransmission of data just received. The data is returned to the sender.

Default — The operating mode assumed when a software switch option is not entered.

Parity — A means for checking that the data received matches the data transmitted. This data checking method is used to verify that the total number of data bits per character is always even or always odd, thus enabling tests to be made for accurate data transmission.

RS232C — A serial communication interface standardized by the Electronic Industries Association (EIA).

90-DAY LIMITED WARRANTY

THIS MYARC RSIC-1 INTERFACE CARD WARRANTY EXTENDS TO THE ORIGINAL CONSUMER PURCHASER OF THE ACCESSORY.

WARRANTY DURATION

This RS232 Interface Card is warranted for a period of 90-days from the date of the original purchase by the consumer.

WARRANTY COVERAGE

This RS232 Interface Card is warranted against defective materials or workmanship. **THIS WARRANTY IS VOID IF THE ACCESSORY HAS BEEN DAMAGED BY ACCIDENT, UNREASONABLE USE, NEGLECT, IMPROPER SERVICE OR OTHER CAUSES NOT ARISING OUT OF DEFECTS IN MATERIALS OR WORKMANSHIP.**

WARRANTY DISCLAIMERS

ANY IMPLIED WARRANTIES ARISING OUT OF THIS SALE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE ABOVE 90-DAY PERIOD. MYARC, INC. SHALL NOT BE LIABLE FOR LOSS OF USE OF THE HARDWARE OR OTHER INCIDENTAL OR CONSEQUENTIAL COSTS, EXPENSES, OR DAMAGES INCURRED BY THE CONSUMER OR ANY OTHER USER.

Some states do not allow the exclusion or limitation of implied warranties or consequential damages, so the above limitations or exclusions may not apply to you in those states.

LEGAL REMEDIES

This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

WARRANTY PERFORMANCE

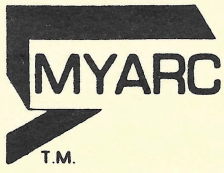
During the above 90-day warranty period, your RS232 Interface Card will be repaired or replaced with a new or reconditioned unit of the same or equivalent model (at MYARC's option) when return is authorized by MYARC and the unit is returned by prepaid shipment to MYARC, INC. at the address shown below. The repaired or replacement unit will be warranted for 90 days from date of repair or replacement. Other than the shipping requirement, no charge will be made for the repair or replacement of in-warranty units.

SHIPPING INSTRUCTIONS: If you believe that your unit requires servicing, please contact MYARC *before* you return your system. We will try to analyse and may be able to solve your problem without need of returning the unit. Please obtain a Return Authorization number from us before you ship the unit back.

MYARC strongly recommends that you insure the unit for value, prior to shipment.

MYARC's ADDRESS:

MYARC, INC.
241 Madisonville Road
Basking Ridge, NJ 07920



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